STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION

STATE GEOLOGICAL SURVEY DIVISION

Morris M. Leighton, Chief

WARSAW AREA

Hancock County

GUIDE LEAFLET 47 D

by

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ITINERARY.

0.0 Warsaw Community High School.
0.0 Go North on city street.
0.2 Stop. Warsaw Highway; turn right (east) on Highway. From Warsaw to Hamilton route is chiefly over upland underlain by Illinoian till and post-Illinoian loess. Occasionally the road dips down as it crosses the heads of rocky glens where post-Illinoian streams have cut down to bed-rock.
3.2 Cross Crystal Glen (west Fork), famous geode collecting locality.
3.5 STOP NO. I. (At junction of Highway 96 with Warsaw Highway). Stop to examine Warsaw shaly limestone and collect geodes.
Continue East on Highway 96.
4.0 STOP NO. II. Pre-glacial (tertiary?) gravel underneath glacial tills. Exposed in gravel pits to NW and SE of road corners. Descending section taken in the NW pit.

Loess and soil 1 foot thick

Illinoian Drift 3 to 4 feet thick

Buff till, leached and weathered; containing numerous fragments of crystalline rocks, granite and gabbro.

Upper 18 inches of this bed is maroon in color and has a somewhat waxy matrix; this "gumbotil" is the result of decomposition of silicate minerals in the till and of deposition of colloidal clay material carried downward by descending surface water.

Kansan Drift (?) average, 2 feet thick

(Observed in the SE pit). Till, more highly weathered than overlying, from which it is separated by a distinct break along a wavy line. Crystalline rocks are chiefly small pebbles. Color, intermottled pale ashy and terra cotta.

Tertiary (?) Deposits. Over 13 feet thick

Upper two thirds coarse gravel, locally cemented by limonite. Pebbles of local material, very highly polished; subangular chert most abundant, highly rounded quartz pebbles common; fragments of geodes present, also masses of indurated sandstone.

Lower third chiefly sand, clean, coarse, poorly sorted, irregularly iron-stained, cross-bedded. Near base of exposure is a loca lense of fine sandstone over and underlain by very fine, ashy gray silt.

This is lowest sediment exposed; there is a short concealed interval down to top bedrock (Warsaw) exposed in stream bed. Stream is Crystal Glen Creek(East fork); geodes abundant in creek bed.

5.7 Highway turns north; continue on highway.
7.4 Railroad crossing in valley of Railroad Creek, famous for geodes.
7.8 Enter Hamilton. Continue straight ahead.
8.2 Stop. Junction Highways 10 and 96; turn left (West) on 96-10.
8.5 STOP NO. III. LUNCH STOP. In Hamilton City park on left (South) side of Highway.
8.6 Leave park and continue west on 96-10.
8.9 Turn right (North) on Highway 96.
Note Keokuk Dam and hydroelectric plant on left.
13.3 Bridge over Waggoner Creek.

14.5 STOP NO. IV. Quarry in Mississippian formations on North bank of Creek. Lower 20 feet is Keokuk Limestone, overlain by about 30 feet of clayey limestone and limey shale. Note gradation from Keokuk beds into Warsaw beds. Small geodes stud some Warsaw layers.

15.0 STOP NO. V. Park in Mt. Mariah picnic ground. Brief stop to observe Mississippian formations, Warsaw formation below grading upward into Salem beds, which are in turn overlain by sandy limestones of the St. Louis formation.

17.6 STOP NO. VI. Quarry in Mississippian Beds on right exposes 23 feet of very fossiliferous Keokuk limestone overlain by about 8 feet of shaly, weathered Warsaw limestone with abundant geodes.

20.6 Leave highway and turn left on first street of Old Nauvoo, the Mormon capital up to 1846.

The Historic marker on the right side of the highway reads as follows:

> "In 1839 the Mormons, or Latter Day Saints, settled at Nauvoo and made it their chief city. During their residence its population reached 15,000. After long friction with non-Mormons, the Mormons were expelled in 1846. Three years later French communists, called Icarians, established a society here which lasted until 1857."

20.9 Turn right (North) at Joseph Smith homestead.

21.7 Crossroad; road to right goes to Nauvoo and Highway 96; continue straight ahead.

21.9 Quarry entrance. Continue on road to left and park at north end of quarry.

22.1 STOP VII. Quarry in Burlington Formation of Mississippian Age.

The Burlington formation lies just below the Keokuk formation, into which it grades. The limestone of Burlington Age has fewer fossils than the Keokuk and tends to be thicker bedded.

BON VOYAGE!

GEOLOGIC HISTORY OF THE WARSAW AREA

The oldest rock which crops out in the Warsaw Area is the Burlington Limestone of Mississippian Age. A glance at the geologic column will show you that the Mississippian Period is late Paleozoic in age, and just precedes the abundantly coal-bearing Pennsylvanian in geologic time. All of the bed-rock outcrops visited on the present trip represent some part of the Mississippian System.

DEEPLY-BURIED STRATA

However, deep wells drilled in the area for oil or water, reveal older formations of Devonian and Ordovician age buried beneath the present surface. Evidence from even deeper wells in adjoining areas shows that below the Ordovician strata are Cambrian sandstones and dolomites. The Devonian, Ordovician, and Cambrian beds originated as sediments, deposited for the most part in ancient seas that flooded the interior of the continent. These sediments, in spite of their great age, have undergone little change except that involved in hardening into sandstone, shale, and limestone. They lie in nearly horizontal layers from the surface down well over a thousand feet. Finally, below the Cambrian sandstones is a twisted complex of crystalline igneous and metamorphic rocks of Proterozoic and Archaeozoic age. These are sometimes referred to as the basement complex, are deeply buried in Illinois, but come to the surface in northern Wisconsin and the region surrounding Lake Superior.

DISTURBANCE OF THE BED ROCK

Although the bedrock layers cropping out on the surface have the appearance of being horizontal, they have in fact been broadly and gently warped by movement of the earth's crust. For example a broad dome exists between Warsaw and Hamilton, whereas a broad trough is present north of Hamilton. This is why the geode-bearing strata in some places crop out high up in the glens, while at other pla ces they lie close to Mississippi River level.

MISSISSIPPIAN FORMATIONS

The outcropping Mississippian strata fall into three natural groups, of which the lowest is the Burlington-Keokuk, the next the Warsaw-Salem, and the highest the St. Louis Formation.

The Burlington-Keokuk consists of limestone strata, gray to white in color, crystalline, and crinoidal. Chert is abundant in some layers and vugs of calcite are common. The Burlington Limestone lies for the most part below river level, but may be seen near Nauvoo (Stop No. VII). The Keokuk Limestone, which is 70 feet thick, is more highly fossiliferous than the underlying Burlington and tend to be grayer, monogranular, and more thinly bedded. Both formations were deposited in marine waters, as is clearly shown by the fossil remains. The two formations are well known for their crinoids, but many other types of organisms occur, including cup-corals, bryozoa ("moss animals"), brachiopod, pelecypod, and gastropod shells, the heads and tails of triobites, and the bones of primitive fish. Most conspicuous among the many types of brachipods is the giant Derbya, which sometimes exceeds 4 inches in width (present at Stop No. V).

WARSAW-SALEM FORMATIONS

Like the Burlington-Keokyk, the Warsaw and Salem formations are grouped together because the former grades upward into the latter. The two formations combined have a thickness of 75 to 90 feet. The lower unit, the Warsaw, is made up of dull gray layers of limey shale and clayey limestone. Fossils are not common, but this lack is compensated by the abundance of geodes which wash or weather out of the soft rock and stud water courses and hillsides. The Salem formation is a porous, granular, highly fossiliferous limestone lying above the Warsaw and interfingering with it.

WARSAW GEODES

The Warsaw Formation is world renowned for the abundance and variety of its geodes. These crystal-lined, or crystal-filled bouldery masses, have a rough shell of chalcedony inside which a variety of minerals may occur. Most common is quartz (rock crystal), but chalcedony, calcite, dolomite, ankerite, and kaolin are common, while sphalerite, marcasite, aragonite, millerite, chalcopyrit and petroleum are sometimes present, as well as such secondary minerals as limonite, smithsonite, malachite, and gypsum.

According to Van Tuyl's theory, geodes originated from the dissolving away of previously existing concretions in the shales, which has left cavities on the walls of which the minerals crystallized and continued to grow until in some cases they completely filled the cavity.

ST. LOUIS FORMATION

The St. Louis Formation is not well exposed in the area covered on the trip. It is peculiar in having many layers made of limestone pebbles cemented to form breccia and conglomerate. At least at the beginning of St. Louis limestone deposition, waters appear to have been shallow, allowing wave action to rip up and redeposit previously formed limestone layers. In places, sand washed into the sea to form sandstone and sandy limestone. But in other places, waters were sufficiently clear to allow large coral reefs to develop, made up principally of the coral Lithostrotion canadense.

LATE MISSISSIPPIAN HISTORY

The St. Louis Limestone is the youngest Mississippian formation found in the Warsaw Area. It seems probable, from a study of other regions, that many hundreds of feet of strata were deposited in Mississippian time above the St. Loui beds. At the close of the Mississippian, and before inundation by the Pennsylvani Sea, the region was a land area, subject to the wearing down process of erosion.

PENNSYLVANIAN HISTORY

Patchy remnants of Pennsylvanian sediments lying high in the hills show clearly that when the sea returned to this region in Pennsylvanian time, the Mississippian strata down to the St. Louis Formation had been stripped away. How great a thickness of Pennsylvanian sediment once overlay the region is not known; it is logical to suppose, from evidence farther east in Illinois, that the thickne was considerable.

MESOZOIC AND CENOZOIC HISTORY

Since the withdrawal of the Pennsylvanian Sea, the region has not been inundated by marine waters. In the millions of years which have intervened between the Pennsylvanian and the present, the region has been a land area undergoing erosion. By the time of the coming of the Pleistocene glaciers, this erosion had removed nearly all of the Pennsylvanian strata with their rich coal beds, and had cut deeply into the Mississippian, as already mentioned. This left a fairly rugged topography like that present today in the unglaciated portions of northwest Illinois and southwest Wisconsin. These irregularities were largel filled up by glacial debris to the present level of the flat upland. Since the withdrawal of the last ice sheet from the region, erosion in places has once again cut down through the mantle of glacial material to carve the ravines and glens along the river.

PRE-GLACIAL GRAVELS

It is rare in the glaciated portion of Illinois to find any evidence of events which took place during the long interval between Pennsylvanian and Pleistocene time. Generally the glacial deposits of our geological yesterday lie directly on the very old Mississippian and Pennsylvanian strata. Occasionally, however, deposits later than Pennsylvanian and earlier than Pleistocene intervene Such deposits are in the nature of gravel and sand left behind by the streams of pre-glacial time. That they ante-date the glaciers is proven, not only by the fact that they lie below the oldest glacial deposits, but also by the fact that all of the pebbles are of local material, where glacial deposits contain a great mixture of rocks, some of which may have traveled a thousand miles from their place of origin.

One of the best of these pre-glacial gravel deposits occurs in the Warsaw area (Stop No. II). Here many of the pebbles are highly polished, suggesting action by wind and sand blast in an arid region. Similar pebbles are typical of late tertiary gravels of western United States. In the absence of bones or other fossils to date the Warsaw gravel, we can only guess at its approximate age Although much of the material in the gravel suggests the effect of wind action, it came to its final resting place in the bed of a fairly large stream which flowed in some unknown age at a level about 160 feet above the present Mississipp

GLACIAL HISTORY

During the Pleistocene Period (or "Great Ice Age"), North America experienced four successive glacial invasions, each separated by long intervals of mild climate. Of these four invasions, the earliest, the Nebraskan, probably reached the Warsaw area, but definite evidence is lacking. The second, or Kansa invasion, moving down from the region west of Hudson Bay, extended across our area and southeast beyond Pittsfield.

When the Kansan ice sheet melted away, it left beyond its "glacial drif rock and debris which mantled the surface and concealed the bed-rock. There followed a long interglacial interval (the Yarmouth Stage), which left its record in the form of old soils and weathered zones on and in the Kansan glacial drift.

From the amount of weathering and leaching that affected the Kansas drift, the length of the Yarmouth Interglacial Stage is estimated at from 200,000 to 300,000 years.

The Yarmouth Interglacial Stage was terminated by the advance of a new glacier, this time coming from the northeast, from a center of accumulation east of Hudson Bay. This Illinoian Ice Sheet is well named, for not only did it cover nearly all of Illinois, but its western termination coincides closely with the western boundary of the State. At Warsaw, we are within four or five miles of the western limit of Illinoian glaciation, which here extended a few miles into Iowa.

In the gravel pit (Stop No. II), we see two glacial tills lying upon pre-glacial gravel. Here, we cannot be sure that the lower till is truly Kansan, because the soil of the Yarmouth Interglacial Stage, if once present, was removed by or before the advance of the Illinoian Glacier.

After several scores of thousands of years, climatic conditions caused the melting away of the Illinoian Ice Sheet. During this warm stage, the upper part of the Illinoian till was weathered and soil developed, just as in the case of the preceding Yarmouth Interval. However, this action did not take place to the degree it did during the Yarmouth, so that the post-Illinoian (Sangamon) interval is estimated to have lasted only about 150,000 years.

The Sangamon Interval was brought to a close by the fourth and final readvance of the glaciers. This Wisconsin Ice Sheet never reached the Warsaw Area, although it threatened it, first from the northwest, later from the northeast. It left its mark on the region, nevertheless. The Mississippi and other streams were choked with sediment washed out from the ice fronts that stood to north, west, and east, The frigid blasts that whipped across these broad sand and mud flats caused violent dust storms. The dust accumulated on the uplands and covered the Illinoian drift and Sangamon soils with a thick layer of loess. This ashy loess, over most of the Warsaw upland, grades into the soil of the present day.

GLACIAL HISTORY OF THE MISSISSIPPI RIVER

At the beginning of, or early in the history of the Great Ice Age, there was no great master stream flowing along the course of the present Mississippi River in the Warsaw Area. The great river left its channel above Rock Island and swung eastward as far as Hennepin, below which its course approximated that of the present Illinois River.

But when the Illinoian Glacier moved down from the northeast it blocked the Mississippi between Savanna and Fulton and forced it to turn westward around the ice lobe. The river then had to cut a new course west even of its present one this old course can be traced today through Iowa a score of miles, more or less, west of the present river. Then when the great ice dam melted away, the river found a short cut and abandoned that portion of its old channel which lies between Cordova in the north and Keokuk in the south.

GENERALIZED GEOLOGIC COLUMN
FOR THE WARSAW AREA
Prepared by the Illinois State Geological Survey

ERAS		PERIODS	EPOCHS	FORMATIONS
Cenozoic "Recent Life"	Age of Mammals	Quaternary	Pleistocene	Recent Post-glacial stage. Wisconsin glacial stage. Sangamon interglacial stage Illinoian glacial stage. Yarmouth interglacial stage. Kansan glacial stage. Aftonian interglacial stage. Nebraskan glacial stage.
		Tertiary	Pliocene Miocene Oligocene Eocene	Stream gravels.
Mesozoic "Middle Life"	Age of Reptiles	Cretaceous		Present in extreme southern Illinois only.
		Jurassic		Not present in Illinois
		Triassic		Not present in Illinois.
Paleozoic "Ancient Life"	Age of Amphibians and Early Plants	Permian		Not present in Illinois.
		Pennsylvanian		Sandstones, siltstones, shales clays, and coal bes.
		Mississippian	Upper	Not present in Warsaw area.
			Lower	Ste. Genevieve limestone. Warsaw-Salem shales and limestone. Burlington-Keokuk limestones.
	Age of Fishes	Devonian		Limestones and shales lying approximately 700 feet below the surface
	Age of Invetebrates	Silurian		Not present in Warsaw area.
		Ordovician		Sandstones, dolomites, and shales lying approximately 800 feet below the surface.
		Cambrian		Sandstones and dolomites lying approximately 1700 feet below the surface.
Proterozoic Archeozoic		} Referred to as "Pre-Cambrian" time.		

BARKLEY

HEAVY WEIGHT
STOCK NO. 5412 1/3